



## **Progress Report**

### **Integrated Warfighter Biodefense Program (IWBP)**

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## EXECUTIVE SUMMARY:

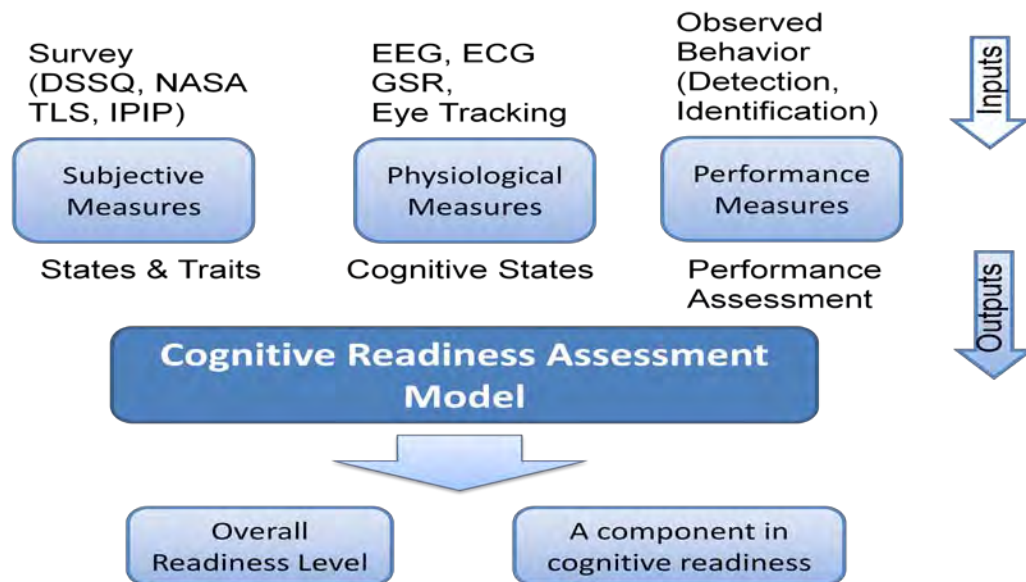
This report outlines Quantum Leap Innovations, Inc. (QLI) accomplishments during the three months of performance between April 1, 2011 and June 30, 2011 on ONR Contract N00014-09-C-0033 for the Integrated Warfighter Biodefense Program (IWBP). The report summarizes activities focused around the following areas:

- QLI continues to validate the multi-dimensional approach to cognitive readiness assessment using the physiological data provided by UCF.
- QLI presented Gryphon at the 2011 US AFRICOM S&T conference in Stuttgart, Germany, June 13-16, 2011.

## SUMMARY OF ACCOMPLISHMENTS:

### Multi-dimensional Approach to Cognitive Readiness Assessment

One goal of this project is to develop a reliable, real-time individualized model for cognitive readiness assessment in complex training environments and in the field. Our initial results in the previous reporting period are promising and indicate that it is possible to quickly calibrate the model built for a group of warfighters with limited physiological data and predict overall performance degradation of individual warfighters in a different group. As shown in Figure 1, we combined subjective ratings, user profiles, performance and physiological measures to predict user workload and other metrics of cognitive readiness of Warfighters. The model was used to assess both a component (e.g., a skill) in cognitive readiness and the overall cognitive readiness.

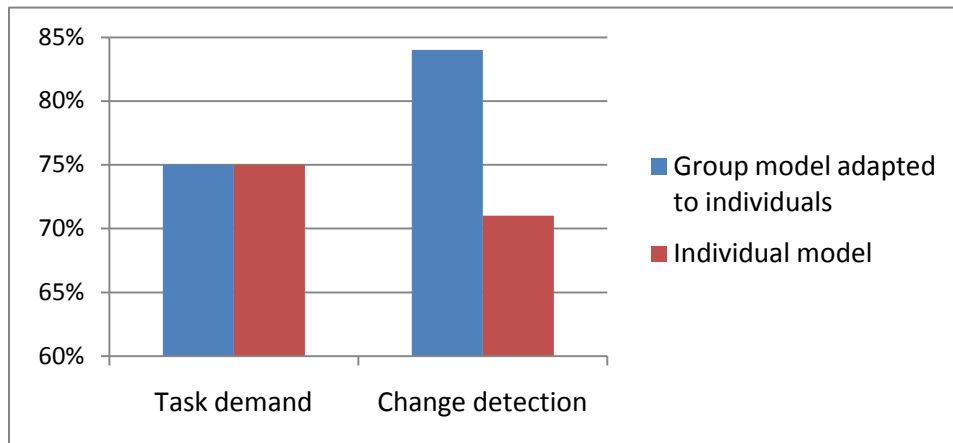


**Figure 1 Model development roadmap in Phase I**

The quarterly report in the previous period discussed several approaches to cognitive readiness assessment. Two of them are particularly interesting. One is to adapt a group model to individuals in a different group using available training data sets. The other is to learn an individual readiness model from scratch. Generally, an individual readiness model learning from scratch might have a higher accuracy for prediction if there are enough data available. This means we would need a relatively long training battery to access the cognitive readiness of Warfighters. The challenge is that in practice training data sets are extremely small and we need to build a model from the small training data sets.

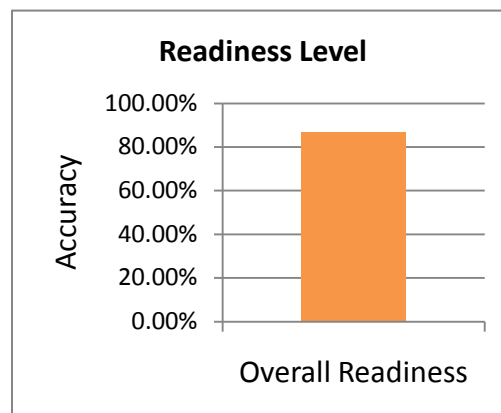
This will greatly shorten the training time for Warfighters, but the risk is that the individual readiness model learning from scratch can be unstable due to limited training data sets.

Alternatively, we can calibrate a group model to assess individual cognitive readiness when the training data sets are small. Figure 2 shows the experimental results for a group model adapted to individuals and individual models learning from scratch when 10% training data sets are used. We can see that the prediction accuracy of task demand, which corresponds to workload or stress in cognitive readiness, are almost the same for group models and individuals. But the group model has a much higher accuracy of change detection compared to individual models. Change detection is related to the pattern recognition skill or perceptual decision making skill in cognitive readiness.



**Figure 2 Experimental results for the components of cognitive readiness**

In addition to the components for cognitive readiness, we also studied the overall readiness level from subjective, physiological measures and performance measures. Currently, performance measure is a weighted sum of the success rates for all tasks and the weight for each task is assumed to be the same, but the approach can be easily generalized to other scenarios with different priorities of tasks. Three tasks are studied as an example for overall cognitive readiness assessment. These include change detection, threat detection and audio response. Figure 3 shows that the accuracy of our existing model can achieve as high as 86% for overall cognitive readiness assessment. The results indicate that the cognitive readiness assessment model being developed in this project is mature enough for further validation and transitioning to the field.



**Figure 3 Experimental results for overall cognitive readiness**

## **Outreach Efforts for Disease Modeling and Simulation**

QLI presented Gryphon infectious disease modeling, simulation and analysis platform at the 2011 US AFRICOM S&T conference in Stuttgart, Germany, June 13-16, 2011. At the conference both COL

Mark Fukuda from Armed Forces Health Surveillance Center (AFHSC) and Dr. Robert Botto, Chief of Physical S&T Division at DTRA, expressed strong interest in the Platform.

## **NEXT STEPS:**

We will continue our outreach efforts in expanding the Gryphon community to the DoD Chemical and Biological Defense and the disease surveillance effort in AFRICOM AOR. Based upon the recommendation of Dr. Botto at DTRA, QLI has scheduled a meeting with Dr. David Stenger at the Naval Research Lab (NRL) to review the capabilities of Gryphon for disease forecasting and analysis in August, 2011. Dr. Stenger is leading an ATD (Advanced Technology Demonstration) effort on biosurveillance in Sierra Leone and is very interested in the capabilities of Gryphon. With additional funding from DTRA and other governmental agencies, QLI will extend Gryphon to support national, regional and local decision makers to analyze the consequences of a bioterrorist attack or disease outbreak and to conduct various what-if analyses for the scale and scope of intervention strategies.

The work executed in the current reporting period for cognitive readiness assessment has provided a significant validation for the LeapWorks Data Analytics platform in cognitive readiness assessment. QLI studied two transition opportunities for the cognitive readiness assessment model: skill screening and adaptive training. Both plans are highly related to cognitive readiness assessment, since cognitive readiness is usually measured by assessing a subset of components of effectiveness such as skills, knowledge, and abilities. The goal of skill screening is to design a training battery to access skills that are important for successful performance of many jobs in Navy and other armed services. In the scenario of adaptive training, the goal is to identify root causes of performance deficits during After-Action Review (AAR) and adjust the difficulty level of scenarios during simulation-based training. Both transition opportunities have been carefully studied by the QLI team. Based on the constraints of software and hardware, the budgeting cycles of technology transition, and the needs of OPNAV, QLI decided to pursue transition opportunities in skill screening.

## **FINANCIAL SUMMARY:**

### **Contract Activity**

QLI Contract N00014-09-C-0033	\$2,240,670
Award date: 03/11/2009	
ACTUAL: Expenditures Invoiced to the Government through June 30, 2011	\$2,207,724
98.5% of Contract Value has been spent as of June 30, 2011	